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FOREST RESOURCES OF THE SOUTH ARKANSAS DELTA

by

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A Progress Report by

THE SOUTHERN FOREST SURVEY

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FOREWORD

The Forest Survey, which is a function of the United States Forest Service, was authorized by the McSweeney-McNary Forest Research Act of 1928 to make a nation-wide study of our forest resources. Its five-fold object is: (1) to make an inventory of the present supply of timber and other forest products, (2) to ascertain the rate at which this supply is being increased through growth, (3) to determine the rate at which this supply is being diminished through industrial and local use, windfall, fire, and disease, (4) to determine the present requirement and the probable future trend in the requirement for timber and other forest products, and (5) to correlate these findings with existing and anticipated economic conditions, in order that policies may be formulated for the effective use of lands suitable for forest production.

This release is based on a field survey made chiefly between August 1934 and April 1935 and on two field canvasses of forest industrial plants to determine forest drain, the last of which was completed during July 1937. It should be regarded only as a progress report, since it contains Forest Survey data that will be included in complete reports to be published later and that, although considered reliable, are subject to correction or amplification as the work of computation proceeds. Item 4 above, which is being studied on a national basis, is not discussed in this report.

In the interpretation of these data, it must be noted that, owing to the sampling method used in collecting them, the greater the number of samples in any given classification the more accurate are the data for that classification. Hence classes that are of infrequent occurrence and relatively small in quantity generally cannot be determined with as high a degree of accuracy as classes that occur more frequently and in substantially greater quantities. Small tabular items are to be taken as showing, not the exact magnitude of the classes involved, but their relative magnitude in comparison with those of other classes.

In the South, the Forest Survey is an activity of the Southern Forest Experiment Station with headquarters at New Orleans, La.

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FOREST RESOURCES OF THE SOUTH ARKANSAS DELTA

Location and General Description

The portion of Arkansas treated in this report is a former flood plain of the Mississippi River, through which the Arkansas, the White, the Mississippi, and other rivers have cut new channels and developed a later flood plain at a lower level. The soils and topography differ accordingly on the two sites. The present flood plains, or bottoms, are generally flat; whereas the earlier flood plains, or terraces, are slightly undulating, and because they are about 10 to 20 feet higher they are usually better drained than the bottoms. Altogether, this area (Forest Survey Unit Arkansas #1) covers some 5 3/4 million acres, including all or parts of 19 counties, as shown in figure 1.

The large areas of natural prairie in the central portion of the unit, chiefly in Arkansas, Lonoke, and Prairie Counties, along with the adjacent cleared lands, are extensively used for the cultivation of rice. Elsewhere in the unit, cotton and corn are the chief agricultural crops. Farm tenancy prevails; more than half of all land in farms is operated by tenants, but tenancy is least in the rice section and greatest in the cotton areas. The plantation system of farming prevails in the southeastern counties along the Mississippi River; elsewhere individual farm operators are more common. According to the 1930 Census, between 20 and 30 percent of the area in farms was woodland.

Agriculture and forest industries are the principal means of support of the present population, which is largely rural. Villages and small towns are common, and only one city, North Little Rock with 20,000 people, had a population of more than 5,000 persons in 1930. On the land adjacent to the Mississippi, Arkansas, White, and Cache Rivers, negroes make up 50 to 65 percent of the population, but in the prairie portion of the unit they make up only 20 to 35 percent.

In the main, this unit is adequately covered by transportation lines. Hard-surfaced and gravel all-weather roads are well distributed; and the Mississippi, Arkansas, and White Rivers afford water transportation. Also the Missouri-Pacific Railroad; the Chicago, Rock Island and Pacific; the Saint Louis Southwestern; the Missouri and Arkansas; and two or three local railroad lines operate in the unit.

The nature of the land use is shown in table 1. More than 47 percent of the total land area supports a forest stand, and 51 percent is agricultural. Less than 2 percent is in waterways, towns and villages, roads, railroads, etc. Of the agricultural land, 69,000 acres is new cropland that had been cleared not more than 5 years at the date of survey. There is reason to believe that since that time new cropland has been cleared at an accelerated rate. The natural fertility of the alluvial soils found extensively in this unit make it inevitable that still greater agricultural development will take place. The relatively large area of idle and abandoned land found by the Survey in 1934 and 1935 was probably due in part to the depressed market for agricultural crops existing at that time; there is reason to believe that some of this idle and abandoned land has already been returned to cultivation and that more of it will be returned to cultivation as economic conditions improve.

Table 1. - Land area classified according to major land uses, 1935

Land use	Total land area	
	Acres	Percent
Forest	2,732,400	47.4
Agricultural:		
In cultivation:		
Old cropland	2,385,600	41.4
New cropland	69,000	1.2
Out of cultivation:		
Idle	195,300	3.4
Abandoned	69,000	1.2
Improved pasture	221,400	3.8
Total agricultural	2,940,300	51.0
Other:		
Nonmeandered waterways, towns, villages, roads, railroads, etc.	93,700	1.6
Total area	5,766,400	100.0

Owing to the speculative value of land for agricultural use, and to the relatively high tax rate, land taxes are higher in the South Arkansas Delta than in the "hill-land" to the west. In addition to the ad valorem taxes, owners of those lands that are within the boundaries of organized drainage and levee districts (of which there are more than 100 separate enterprises in the unit) paid an average drainage and levee tax of 42¢ per acre in 1933, although in individual districts the tax was much greater. This adverse tax situation tends to discourage private timber growing except on the batture (i.e., lands lying between the levee and stream or river bank) or on other areas free in large part from excessive drainage and levee taxes.

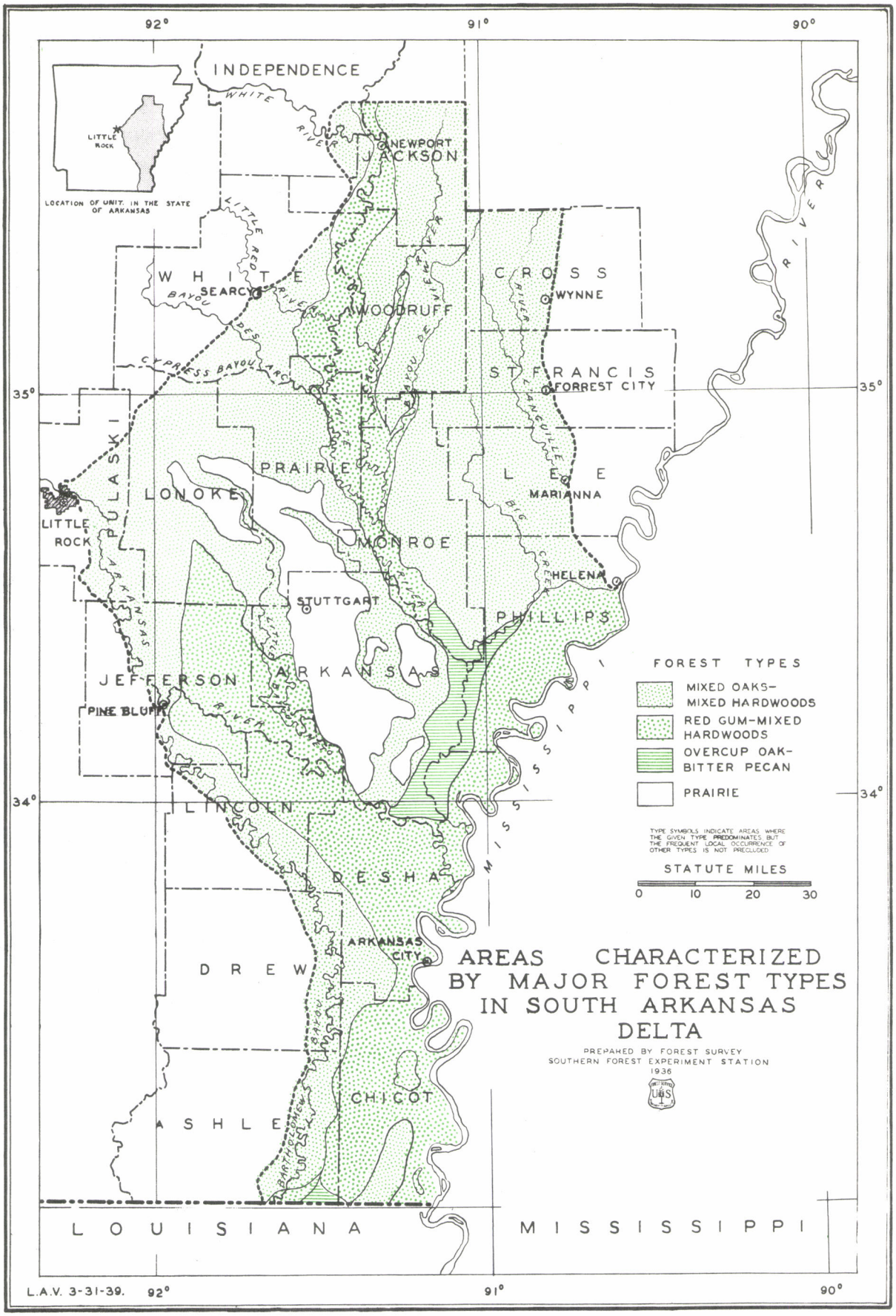

FIGURE 1.- FOREST TYPE MAP.

Forest Description

Except for the prairies already mentioned, this unit was originally forested with a dense stand of virgin hardwood timber. By the early 19th century, agricultural settlement was well under way along the frontlands of the Mississippi and Arkansas Rivers. In 1819, Nuttall 1/ recorded in his journal that along the lower reaches of the Arkansas River there existed a line of settlements, and that the greatest uninhabited interval did not exceed 30 miles. Timber cuttings were made almost exclusively for the clearing of land and for lumber to be used in local construction until about 1890, when sawmills were established to cut lumber for shipment by rail or water to Northern markets, part of the needs of which are still supplied by mills in this unit.

Practically all the large holdings of virgin timberland have been cut over, and the remaining areas of uncut old growth are mostly small and scattered. Although the most accessible and desirable land has been put into cultivation, much of the present forest area is potential agricultural land and may become so if future economic conditions warrant its improvement and use for this purpose. A few localities, such as the batture lands and the backwater area along the lower reaches of the Arkansas and White Rivers, which are subject to overflow almost yearly, can be expected to continue indefinitely in forest.

The situation in regard to the forest area is shown in greater detail in table 2, where this area is classified into nine forest types on the basis of species composition, and into five forest conditions on the basis of the character of the timber stands. The types shown here are somewhat more specific than those given in figure 1, where the small area of pine-hardwood type has been included with the mixed oaks-mixed hardwood type; and other types, unspecified in figure 1, have been included with the red gum-mixed hardwoods type. The mixed oaks-mixed hardwood type of the terraces covers the largest proportion of the forest area, with the red gum-water oak and hackberry-elm-ash types following in order. The overcup oak-bitter pecan type accounts for the largest proportion of the uncut old-growth condition, largely because the principal species of this type are not in demand at the present time.

The total forest area has been further subdivided on the basis of stand per acre and quality of timber into class-A and class-B areas. A class-A area is one that supports a stand of adequate quality and volume per acre to warrant operation under present market conditions for such higher-grade products as industrial lumber, cooperage stock, or veneer. Since practically all the forest area in this unit is accessible for logging during some season of the year, and since motor transportation makes practicable the logging of relatively sparse stands, forest areas bearing 1,000 board feet per acre or more of higher-grade material are considered to be in class A. Class-B areas include all forest lands that do not meet these qualifications; some of these areas, which frequently bear stands suitable for cross ties, structural timbers, and lumber for domestic use, in time will develop through growth into class-A areas.

1/ Nuttall, Thomas. In: Early Western Travels, 1748-1846. Vol. 13. Edited by Reuben G. Thwaites.

Table 2. -- Distribution of total forest area in the various forest types and forest conditions, 1935

Forest type	Old growth		Second growth, sawlog size		Second growth, under sawlog size, reproduction, and clear-cut	All conditions	
	Uncut	Partly cut	Uncut	Partly cut			
	Acres						Percent
Red gum-water oak	25,400	59,500	150,000	48,400	172,200	455,500	16.7
Mixed oak mixed hardwood	24,600	100,000	196,000	160,300	301,600	782,500	28.6
Overcup oak-bitter pecan	54,000	105,600	80,200	34,100	64,200	338,100	12.4
Water oak	8,700	53,100	113,500	76,200	67,500	319,000	11.7
Hackberry-elm-ash	21,400	108,700	150,800	39,700	97,600	418,200	15.3
Cottonwood-willow	-	-	78,600	15,900	107,900	202,400	7.4
Cypress-tupelo gum	6,300	23,000	21,400	19,900	19,900	90,500	3.3
Pine-hardwood	-	-	17,400	14,300	9,600	41,300	1.5
Scrub oak-scrub hardwood	1/	1/	5,500	5,500	65,100	84,900	3.1
Total	144,400	454,700	813,400	414,300	2/905,600	2,732,400	100.0
Percent of total	5.3	16.6	29.8	15.2	33.1	100.0	

1/ Although the Survey data show an area in this type and condition, it is too small to indicate accurately even the relative magnitude of the individual item. The area estimated, however, is carried in the total for the type and condition.

2/ Of this area, only about 4 percent can be classed as clear-cut.

Material of the higher grades is contained specifically in logs used for lumber and veneer, and other higher-quality logs suitable chiefly for the manufacture of cooperage and specialty stock. Lumber logs are those at least 14 inches (12 inches in ash) in diameter that can be expected to yield at least 30 percent of their lumber volume in grades No. 1 common and better. Logs in this class average about 60 percent of their volume in these grades of lumber. Cooperage logs and logs for specialty stock are at least 10 inches in diameter and of the same general quality as lumber logs, but they cannot be so classified because of their small diameter or excessive sweep. These small, higher-grade logs are suitable for industrial uses that require bolts or blocks rather than logs. In cypress and pine the higher-grade trees are those that will cut at least 80 to 90 percent of their lumber volume in grades No. 2 common and better, and that, in addition, will produce more than 5 percent in firsts and seconds or in B and better. Lower-grade logs of all species are those that do not meet the above qualifications. The volume of higher-grade material found in partly cut sawlog-size stands is largely made up of species that did not at the time of the last cutting have a well-established market, of logs that grew into their present size and quality since the last cutting, or of small logs suitable only for cooperage and specialty stock.

Of the total forest area, only about 340,000 acres, or 12 percent, supports a sufficient volume (1,000 board feet or more per acre) of higher-quality timber to be classified as class A. Of this class-A area, approximately 24 percent is in the old-growth uncut condition, 32 percent in the old-growth partly cut condition, and 44 percent in the second-growth sawlog-size conditions. More than two-fifths of the class-A forest area is in the red gum-mixed hardwoods type and the mixed oaks-mixed hardwoods type characteristic of the bottoms and terraces, respectively.

Forest Inventory

The volume estimate has been broken down into saw-timber volume, expressed in board feet, and into cordwood volume. The former includes the net volume of all usable logs in good trees of sawlog size, regardless of log grades. Such trees are at least 13.0 inches d.b.h.[2/] (9.0 inches in pine) and contain at least one 12-foot usable butt log (i.e., one at least 50 percent sound and 10 inches or more in diameter at the small end in hardwood, and 6 inches or more in pine). If the butt log is cull, these trees must contain at least 50 percent of their volume in material suitable for the manufacture of lumber of commercial grade, low-grade structural material, low-grade box material, or railroad cross ties. The saw-timber volume, however, includes neither the volume of sound cull and rotten cull trees nor the cull volume in good trees.

The cordwood volume of trees under sawlog size (5.0 - 12.9 inches d.b.h. in hardwood and cypress, and 5.0 - 8.9 inches in pine) includes the wood and bark of the main stem to a usable top, the minimum allowable top being never

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2/ "D.B.H." is the abbreviation for "diameter at breast height," which is the tree diameter at 4½ feet above the ground. The Survey uses 2-inch diameter-classes; thus, for example, the lower and upper limits of the 14-inch diameter-class are 13.0 and 14.9 inches, respectively.

less than 4 inches and seldom more than 8. The cordwood volume is also net, i.e., the volume of cull material that normally would be left in the woods as waste has not been included.

Board-foot volume

The total net volume according to the Doyle log rule, as shown in table 3, is 4.6 billion board feet (1935). This total is distributed among the forest conditions as follows: 19 percent is in the old-growth uncut condition, 28 percent is in the old-growth partly cut condition, and 53 percent is in the remaining second-growth and reproduction conditions. Considering the total board-foot volume from another point of view, less than 37 percent is in the higher-quality (class-A) stands; approximately 45 percent of this is higher-grade material suitable for industrial lumber, veneer, and cooperage. In the stands of lower quality (class-B), only 10 percent of the total board-foot volume is higher-grade material. Of the total volume on both class-A and class-B areas, 23 percent is of the higher grades. The distribution of the higher- and lower-grade material among the sawlog-size forest conditions is shown in figure 2. These data indicate plainly that the timber volume in this unit is largely of lower quality and that it is largely in partly cut old-growth and in second-growth stands.

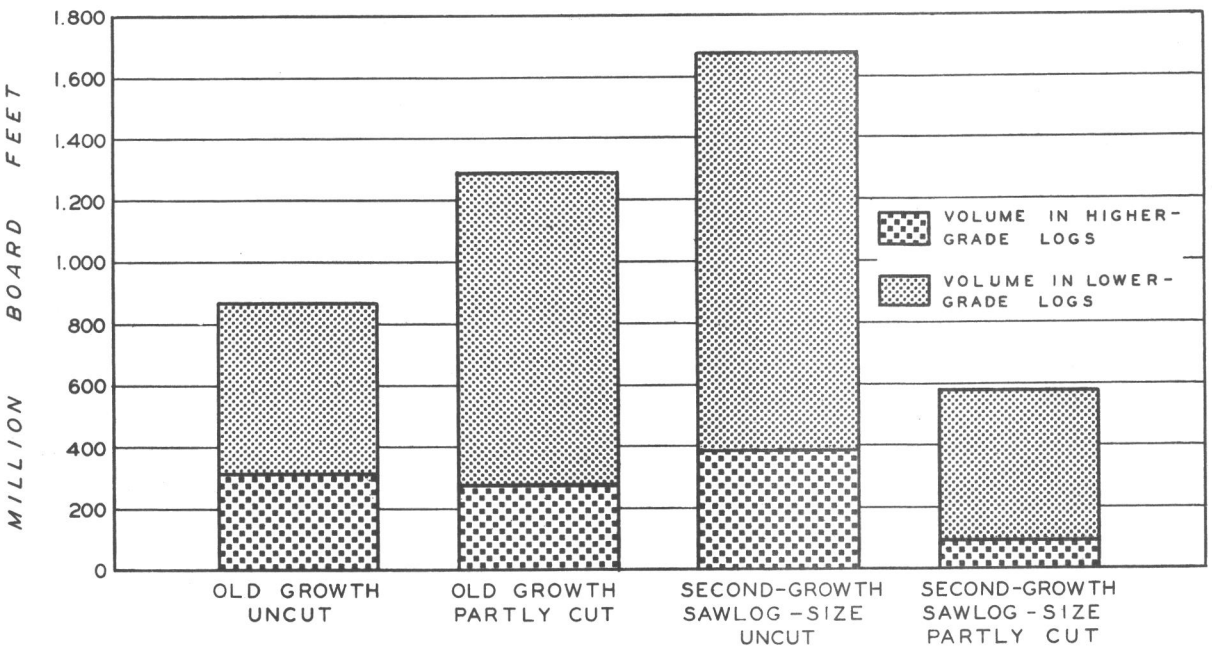

FIGURE 2.- TIMBER VOLUME BY FOREST CONDITIONS AND QUALITY-CLASSES.

Table 3. - Total net volume of good trees on forest areas, by forest conditions and species-groups, 1935

I. BY FOREST CONDITIONS

Forest condition and species-group	Volume on class-A areas			Volume on class-B areas			Total volume	
	Saw timber (Doyle)		Cordwood[1/]	Saw timber (Doyle)		Cordwood[1/]	Saw timber (Doyle)	Cordwood[1/]
	In higher-grade logs	In lower-grade logs		In higher-grade logs	In lower-grade logs			
	M bd.ft.	M bd.ft.	Cords	M bd.ft.	M bd.ft.	Cords	M bd.ft.	Cords
Old growth:								
Uncut	272,500	300,000	496,000	29,100	268,600	352,100	870,200	848,100
Partly cut	200,600	286,200	445,500	74,900	726,400	1,251,900	1,288,100	1,697,400
Second growth:								
Sawlog size:								
Uncut	256,800	274,000	720,900	126,500	1,015,900	4,034,100	1,673,200	4,755,000
Partly cut	33,200	54,100	182,800	57,800	440,500	1,994,700	585,600	2,177,500
Under sawlog size	-	-	-	7,300	135,500	3,382,000	142,800	3,382,000
Reproduction	-	-	-	-	4,500	10,300	4,500	10,300
Clear-cut	-	-	-	-	1,600	9,400	1,600	9,400
Total	763,100	914,300	1,845,200	295,600	2,593,000	11,034,500	4,566,000	12,879,700

II. BY SPECIES-GROUPS

Red gum	151,800	137,000	196,300	38,400	176,800	1,133,900	504,000	1,330,200
Water oaks	52,700	131,700	134,600	46,500	645,600	1,950,000	876,500	2,084,600
Red oaks	23,400	28,000	48,800	21,100	141,900	935,000	214,400	983,800
White oaks	39,000	38,900	52,500	19,200	117,800	628,700	214,900	681,200
Overcup oak 2/	40,300	123,900	156,900	21,200	351,700	1,064,900	537,100	1,221,800
Ash	46,700	40,100	162,500	19,000	59,100	546,500	164,900	709,000
Cottonwood	107,700	97,400	30,100	9,000	111,300	239,800	325,400	269,900
Willows	25,200	19,400	59,900	8,400	57,500	350,500	110,500	410,400
Elms 3/	33,300	56,200	134,600	19,400	339,100	1,133,500	448,000	1,268,100
Black and tupelo gums 4/	50,900	40,000	103,200	16,200	52,800	261,800	159,900	365,000
Cypress	44,900	13,400	53,600	9,300	26,400	138,300	94,000	191,900
Bitter pecan	25,600	62,200	92,700	8,600	169,100	565,500	265,500	658,200
Hickories 5/	39,800	44,400	119,700	9,600	121,800	700,500	215,600	820,200
Hackberry	28,800	33,600	261,800	20,000	110,700	580,400	193,100	842,200
Miscellaneous 6/	53,000	48,100	238,000	29,700	111,400	805,200	242,200	1,043,200
Total	763,100	914,300	1,845,200	295,600	2,593,000	11,034,500	4,566,000	12,879,700

1/ Cordwood volume of trees under sawlog size, including the wood and bark of the main stem to a usable top, the minimum allowable top never being less than 4 inches and seldom more than 8. Cordwood volume was calculated on a basis of 80 cubic feet per cord for hardwood species and 90 cubic feet for pine and cypress. Only woods cull was deducted from the cordwood volume.

2/ Approximately 10 percent of this volume is "hill" post oak.

3/ Approximately 55 percent of this volume is white elm.

4/ Approximately 40 percent of this volume is black gum.

5/ Approximately 40 percent of this volume is sweet pecan.

6/ Includes a small volume of pine (approximately 44 million board feet and 67,000 cords).

The water oaks species-group has the largest volume, with a total of 876 million board feet. Overcup oak, red gum, and the elm group follow in order. It is significant from the point of view of wood utilization that nearly 90 percent of the board-foot volume in overcup oak and also in bitter pecan is in the lower-grade logs, for which the finding of a market outlet is a very important problem.

A sharper picture than that given in table 3 perhaps can be obtained from table 4, where the average stand per acre is shown on class-A and class-B areas by forest conditions, higher-grade and lower-grade material combined. Class-A areas averaged 4,970 board feet per acre and class-B areas 1,210 board feet. The average stand per acre of the total forest area was 1,670 board feet, but for the forest conditions that are characterized by sawlog-size stands it was 2,420 board feet.

Table 4. - Average number of board feet per acre (Doyle log scale) on class-A and class-B areas, classified by forest conditions, 1935.

Forest condition	Class-A areas	Class-B areas	Weighted average
	Board feet (Doyle)		
Old growth:			
Uncut	7,010	4,750	6,000
Partly cut	4,580	2,300	2,830
Second growth:			
Sawlog size:			
Uncut	4,460	1,650	2,060
Partly cut	2,890	1,300	1,400
Under sawlog size, reproduction, clear-cut, and nonproductive areas	-	160	160
Weighted average, all conditions	4,970	1,210	1,670

Although the Doyle rule is the legal rule of Arkansas and is in general use for timber estimates in the South, its application to stands made up mainly of small trees results in an understatement of the actual volume recoverable in lumber. The volume in this Survey unit, according to the International $\frac{1}{4}$-inch log rule, which closely approximates green lumber tally, is 6.2 billion board feet; according to the Scribner log rule, it is 5.6 billion board feet. The average stand per acre, with the International $\frac{1}{4}$-inch rule, is 2,280 board feet

as compared to 1,670 board feet with the Doyle rule. Hereafter in this report, because of the necessity of correlating drain expressed in lumber tally with volume and increment figures, the International $\frac{1}{4}$-inch rule is used to represent green lumber tally.

Cordwood volume

In addition to the saw-timber volume and the volume in sound trees under sawlog size already shown in table 3, there is, as determined by a very rough estimate, 14.1 million standard (4 x 4 x 8 feet) cords of sound wood including bark, which is classified as follows:

Source	Cords
Tops and limbs of good trees of sawlog size.....	9,254,000
Sound wood in stems, tops, and limbs of cull trees..	4,827,300
	14,081,300

In sawlog-size trees, this cordwood volume includes that portion of the main stem above the usable sawlog limit and also the volume of all hardwood and cypress limbwood over 4 inches in diameter. In cull trees, this volume includes all sound stemwood in trees 5.0 inches d.b.h. and larger, together with sound limbwood in sawlog-size hardwood and cypress trees. Although this material is sound and suitable for many uses, little is now being marketed because of lack of demand. The total cordwood volume, including good trees under sawlog size, tops and limbs of sawlog-size trees, and cull trees, is approximately 26,961,000 cords.

Cubic-foot volume

The cubic-foot equivalent of the total saw-timber volume is (1935) 1,089 million cubic feet inside bark, and the cubic volume of good trees under sawlog size, but at least 5.0 inches d.b.h., is 820 million cubic feet excluding bark; therefore, the total cubic volume in good trees only, excluding cull trees, tops, and limbs, is 1,909 million cubic feet.

Forest Increment

The net annual forest increment is the volume added during the year by growth to the individual trees, plus the merchantable volume newly created by small trees developing into merchantable sizes, and minus the losses due to mortality. This net increment represents, in a general way, the cut that can be made each year without reducing the volume of the original growing stock.

Board-foot increment, therefore, is made up of (1) the growth on trees already of sawlog size, plus (2) the total board-foot volume in trees becoming sawlog size during the year, minus (3) the losses due to mortality. This increment, which is expressed in green lumber tally, is based on good trees only, from which all cull material is excluded. Similarly, cubic-foot increment represents (1) the growth on sound stemwood in good trees at least 5.0 inches d.b.h. (including in sawlog-size trees only the saw-timber material), plus (2) the total volume (excluding cull material) of small trees becoming at least 5.0 inches d.b.h. during the year, minus (3) the losses due to mortality.

Table 5 shows the 1935 increment per acre in the various forest conditions in terms of board feet and cubic feet, excluding bark. In calculating these increments, deductions for natural mortality have been made; but no deductions have been made for material removed in timber-cutting operations or for the effect of this cutting on the year's increment. Cubic-foot increment includes material in the sawlog portion of sawlog-size trees, in the upper stems of sawlog-size pines, and in trees under sawlog size.

Table 5. - Average increment[1/] per acre of class-A and class-B forests by forest conditions, 1935.

Forest condition	Annual increment	
	Board feet (green lumber tally 2/)	Cubic feet (inside bark)
Class-A area:		
Old growth, uncut	143	20.4
Old growth, partly cut	70	14.5
Second growth, sawlog size	265	36.1
Class-B area:		
Old growth, uncut	121	18.3
Old growth, partly cut	60	13.9
Second growth, sawlog size	144	27.4
Second growth, under sawlog size	42	25.0
All conditions[3/]	100	23.2

1/ Figures in this table do not include increment resulting from the change of class-B areas to class-A areas (see footnote 3, table 6).
2/ Based on International $\frac{1}{4}$-inch rule
3/ Reproduction and clear-cut conditions included.

The average increment per acre for the entire forest was 100 board feet or 23.2 cubic feet in 1935. On the 149,300 acres of second-growth sawlog-size class-A area, the increment per acre averaged 265 board feet, or 36.1 cubic feet. The relatively high increment in the old-growth uncut stands is largely due to a high volume per acre and to the fact that even in stands characterized by old-growth trees some of the trees are of a younger age-class and are rapid growing.

Table 6 shows the total net volume of wood added to the inventory of good trees on the entire forest area during 1935, expressed in board feet (lumber tally) for sawlog-size material, and in standard cords (4 x 4 x 8 feet) for material under sawlog size. In arriving at these estimates, deductions were made for natural losses but not for the effect of timber cutting. The movement of trees from one diameter-group to another was also taken into account, as well as the advancement of certain areas from class B to class A. The total

Table 6. - Forest increment,[1] classified according to forest condition, 1935

Forest condition	Increment[2] in trees under sawlog size			Increment in sawlog-size trees						
				Diameter-classes 14-18 in.		Diameter-classes 20 in. and over		All sawlog-size trees		
	Class-A area[3]	Class-B area	Total	Class-A area[3]	Class-B area	Class-A area[3]	Class-B area	Class-A area[3]	Class-B area	Total
	---- Cords ----			---------- M board feet (green lumber tally) ----------						
Old growth:										
Uncut	3,000	2,400	5,400	7,600	100	15,700	[3] -4,100	23,300	[3] -4,000	19,300
Partly cut	10,200	32,000	42,200	6,500	2,000	13,500	6,400	20,000	8,400	28,400
Second growth:										
Sawlog size	14,800	131,700	146,500	49,600	63,200	69,700	12,500	119,300	75,700	195,000
Under sawlog size	500	267,600	268,100	400	33,700	2,300	[3] -3,500	2,700	30,200	32,900
Reproduction and clear-cut	-	[4] -4,300	[4] -4,300	-	[3] -1,100	-	[3] -800	-	[3] -1,900	[3] -1,900
Total all conditions	28,500	429,400	457,900	64,100	97,900	101,200	10,500	165,300	108,400	273,700

1/ These increment figures are based on the assumption that no cutting takes place. A total increment of 265,600 M board feet is obtained when the 1935 timber cut enters into the calculation.

2/ This increment includes the annual growth on trees at least 5.0 inches d.b.h. that remain under sawlog size throughout the year, plus the volume in trees that during the year move into the 6-inch diameter-class.

3/ The annual increment on class-A forest areas includes not only the increment on areas that were class-A at the beginning of the year, but also the total timber volume added through movement of areas from class-B to class-A as a result of 1 year's growth. A negative board-foot increment on class-B forest areas indicates (1) that the volumes on areas moving from class-B to class-A were greater than the increment on areas remaining in class-B, and (2) that the mortality in residual stands is heavy.

4/ A negative annual increment of trees under sawlog size means that the volume of trees changing from under sawlog size to sawlog size is greater than the increment of the trees that were under sawlog size at the end of the year (see footnote 2).

increment for all forest conditions was 273.7 million board feet. It is significant from the standpoint of the timber operation that 60 percent of this total occurred on class-A forest areas and 41 percent was in trees 20 inches d.b.h. and larger. It is therefore apparent that approximately half the board-foot increment is being laid on trees that either occur in stands that are attractive to operators or are of a size suitable for industrial utilization.

As might be expected, a very large proportion (94 percent) of the total cordwood increment of 457,900 cords is on class-B areas, where the proportion of trees under sawlog size is largest. This shows plainly that a very large part of the increment in trees under sawlog size is being added on areas that bear too small a volume of marketable material to be attractive at present to industrial lumber operators; these areas, aggregating 2.4 million acres, must be held until their timber reaches merchantable size.

Forest-Products Industries

In 1937, the South Arkansas Delta supported within its boundaries 201 forest-industrial plants, of which 143 were sawmills (fig. 3). In addition, 12 sawmills and 16 nonlumber forest-industrial plants located chiefly in Memphis, in west Mississippi, and in other parts of Arkansas, drew a substantial volume of logs from the forests of this unit.

Lumber industry

The medium-sized and large sawmills in this unit, of which there were 13 in 1937 (table 7), are the remnants of the industrial setup which during the past four decades cut the virgin hardwood timber for the nation's industrial hardwood-lumber market. These mills are still cutting some virgin timber, but for the most part they are relying on second and third cuttings of forest land. In the main, they are of the single-band type, are operated by steam power, and are equipped to produce standard grades of well-manufactured lumber, which is usually air dried. Owing to exhaustion of nearby timber supplies of a quality to meet their requirements, several of these mills probably will be abandoned or moved within the next few years. Others, especially those near the Mississippi River where water transportation lengthens the logging reach, and where fast-growing, low-cost batture timber is available, can be expected to continue longer, perhaps indefinitely.

The small portable mills, of which there were about 130 in 1937, differ from one another chiefly with respect to kind of ownership. Some are owned by farmers and operated intermittently in connection with farming; others are owned by commercial operators, who make a large part of their living by cutting lumber, timbers, or ties. The farm mills are usually operated by a steam or gasoline engine, and their equipment usually consists of only a circular saw and a log carriage with occasionally an edger and cut-off saw. These mills, most of which have a capacity of 3,000 to 6,000 board feet per day, generally operate only 10 to 60 days during the year. The commercial mills may differ very little in equipment from the farm mills, but they usually have a somewhat larger capacity and operate a greater portion of the year.

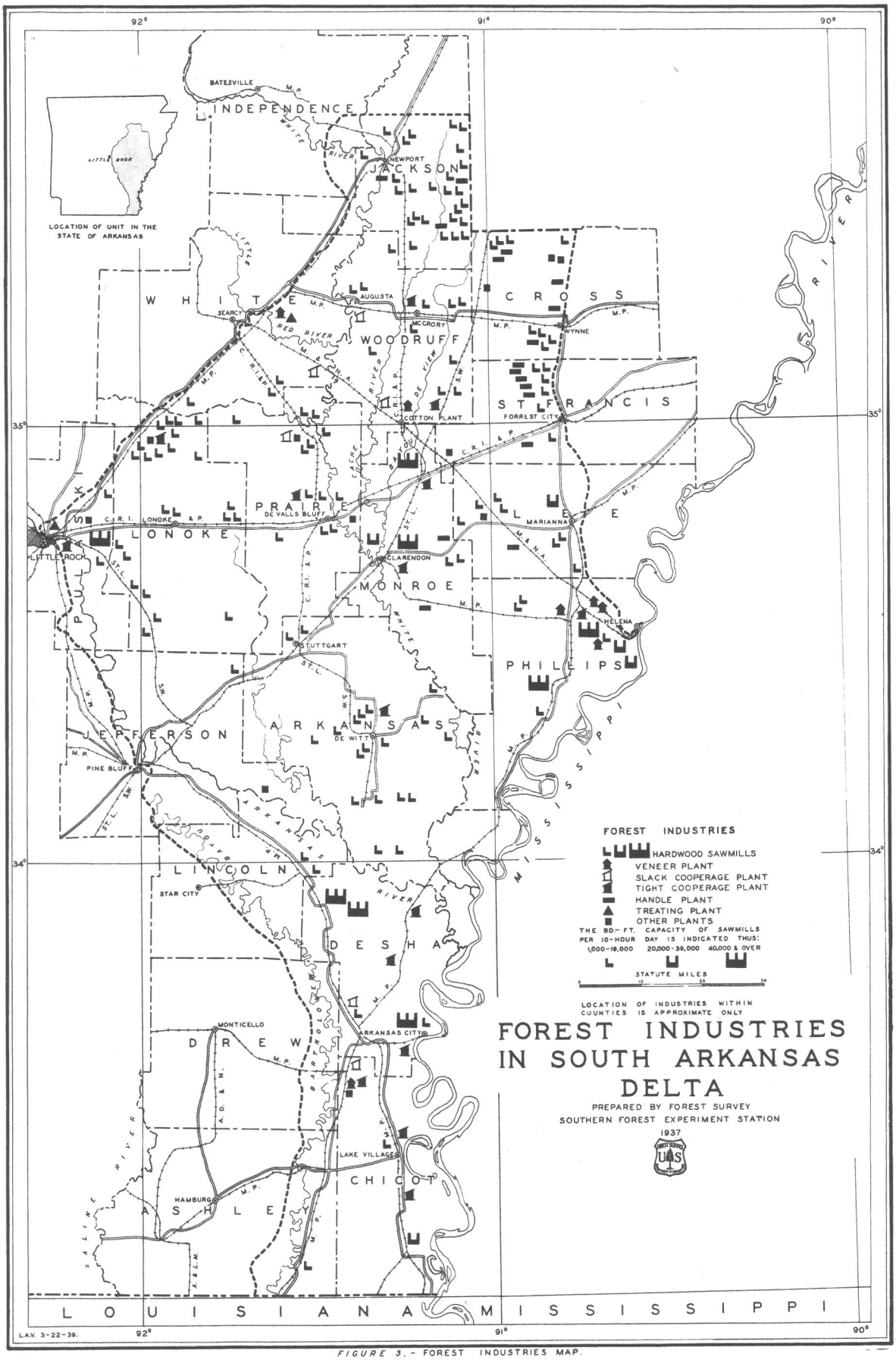

FIGURE 3.- FOREST INDUSTRIES MAP.

Table 7. - Production and employment data in the lumber industry, 1937[1/]

Daily capacity	Mills	Produced by mills in the unit	Mill employment	Produced from forests of the unit	Woods employment
M bd.ft.	Number	M bd.ft.	Thousand man-days	M bd.ft.	Thousand man-days
Under 20	130	34,800	52	34,800	42
20 - 39	5	17,500	36	27,400	40
40 and over	8	62,900	110	103,000	134
Total	143	115,200	198	165,200	216

1/ Based on a 10-hour operating day and green lumber tally.

Although the medium-sized and large mills are scattered more or less indiscriminately throughout the unit, the small portable mills are concentrated in the north and west portions, away from the frontlands of the Mississippi River and the plantation country (fig. 3). These sawmills are found in the portion of the unit where small, isolated patches of workable timber occur, and where small, independent farm operators are common.

In 1937, the timber cut from the forests of the unit for manufacturing into lumber both inside and outside the unit amounted to 165 million board feet. Comparison of this figure with the 115 million board feet cut by sawmills of the unit indicates that more logs were cut and shipped outside for manufacturing than were cut outside and brought in for sawmilling. The 13 sawmills with a daily capacity of 20,000 board feet and over accounted for 70 percent of the lumber production, whereas the 130 small mills accounted for only 30 percent of the total cut (table 7). The production increased from 98 million board feet in 1935 to 129 million board feet in 1936, but dropped to 115 million in 1937.

Nonlumber industries

Table 8 shows in the unit 58 nonlumber primary wood-using plants, which can operate, in large part, on either smaller higher-quality trees and logs or on lower-quality material found in second-growth and partly cut old-growth stands; more than 80 percent of the board-foot volume in this unit is in such stands. These plants accounted for 227,000 man-days of mill employment, while the woods employment afforded by nonlumber forest-industrial plants drawing from this unit amounted to 246,000 man-days.

Table 8. - Production and employment data[1] in the nonlumber forest industries, 1937

Kind of plant or commodity	Plants in unit	Produced by plants in unit	Plant employment	Produced from forests in unit	Woods employment
	Number	M bd.ft.	Thousand man-days	M bd.ft.	Thousand man-days
Veneer	7	35,000	42	41,100	54
		Pieces		Pieces	
Hewed cross ties	-	-	-	764,400	92
Poles and piles	-	-	-	1,600	1
		Cords		Cords	
Tight-cooperage material	14	15,000	18	14,500	23
Slack-cooperage material	6	18,000	29	15,500	16
Chemical wood	-	-	-	17,700	23
Handles	17	3,000	5	3,100	6
Pulpwood	-	-	-	14,400	15
Miscellaneous[2]	14	114,200	133	10,800	16
Total	58		227		246

1/ Cordwood volume is expressed in standard (4 x 4 x 8 feet) cords, including bark. Board-foot volumes are in terms of the International $\frac{1}{4}$-inch log rule. Man-days are based on a 10-hour day.

2/ Includes 2 treating plants, 3 shingle mills, 7 small-dimension plants, 1 excelsior plant, and 1 plant making net hoops.

Employment

With the data available, it is impossible to translate the total employment figure of 887,000 man-days into the exact number of persons receiving either full- or part-time employment in the forest industries; on the basis, however, of 200 working days per year, this amount of employment would furnish full-time occupation for about 4,500 persons. In consideration of the number of small forest-industrial plants working intermittently, it is possible that as many as 9,000 persons receive full- or part-time employment in the forests and mills of this unit. To this should be added the labor involved in cutting the 0.6 million cords of fuel wood (from live growing stock and from dead and cull trees, cut both on and off farms) and the 3 million fence posts used in this unit; this probably amounts to approximately 816,000 man-days. Although only a small portion of this additional employment — possibly not more than 10 percent — was for cash wages, it represents an important employment item in the life of the people. The material thus produced, without cash outlay and usually without interference in normal gainful employment, is a substitute for material that would otherwise have to be purchased.

Forest Drain

In table 9 is shown the total volume of wood removed from the growing stock of the unit during 1937 for use in industry and for domestic purposes. This volume, termed forest drain, is the total volume of usable material removed from the growing stock by cutting. It does not include losses due to mortality, which are taken into account in calculating the increment; neither does it include material cut from cull and dead trees or from limbs, none of which is considered to be a part of the growing stock. Thus, drain in board feet in table 9 includes the volume actually used (from tables 7 and 8), plus the volume left in the woods as cutting waste because, although it met the Survey specifications for usable material, it did not meet the requirements of the particular user or of the current market. In the last column of table 9, drain is expressed in cubic feet, inside bark. It includes both the sawlog portion of sawlog-size trees and the contents of the main stem of good trees at least 5.0 inches d.b.h. but under sawlog size.

Table 9. - Net volume of timber drain from the growing stock, 1937

Commodity	From sawlog-size trees	From all trees 5.0 inches d.b.h. and larger
	- - - M bd. ft. - - -	- M cu. ft. (i.b.) -
Lumber	186,000	28,000
Veneer	46,500	6,760
Tight-cooperage material	9,900	1,490
Slack-cooperage material	10,600	1,630
Poles and piles	200	40
Hewed cross ties	35,600	6,000
Handles	1,300	340
Pulpwood	300	820
Material used by miscellaneous industries	5,400	2,280
Material cut in clearing land	17,800	5,230
Material cut for fuel, farm fence posts, and other domestic uses	29,700	17,210
Total	343,300	69,800

The total 1937 drain from sawlog-size trees of the growing stock was 343 million board feet, and corresponding drain against the total growing stock, including material in all trees 5.0 inches d.b.h. and larger was 70 million cubic feet. In 1936, the board-foot and cubic-foot drain against the growing stock was 396 million board feet and 77 million cubic feet, respectively. In 1935, the comparable drain was 314 million board feet and 64 million cubic feet. It is estimated that at least 60 percent of this board-foot drain is taken from class-A areas, which furnish a high proportion of the

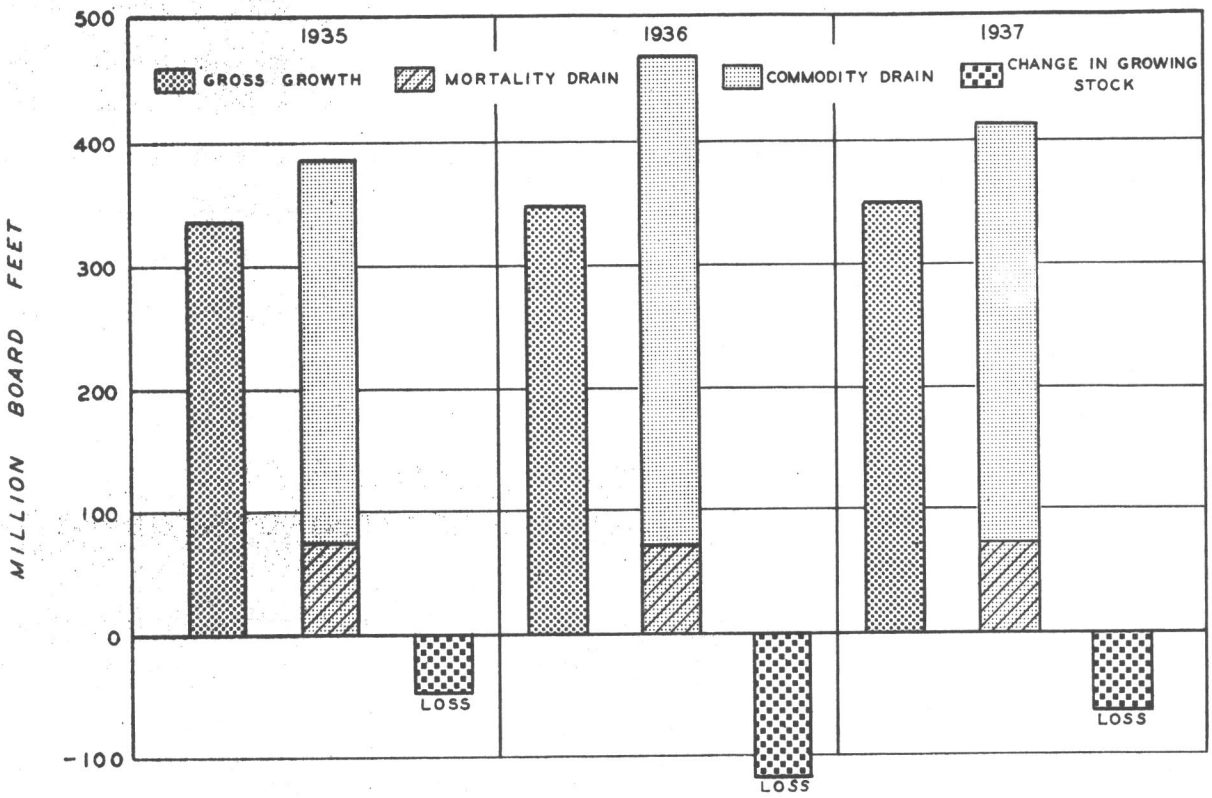

FIGURE 4. - COMPARISON OF GROSS GROWTH AND TOTAL DRAIN OF SAW-TIMBER MATERIAL

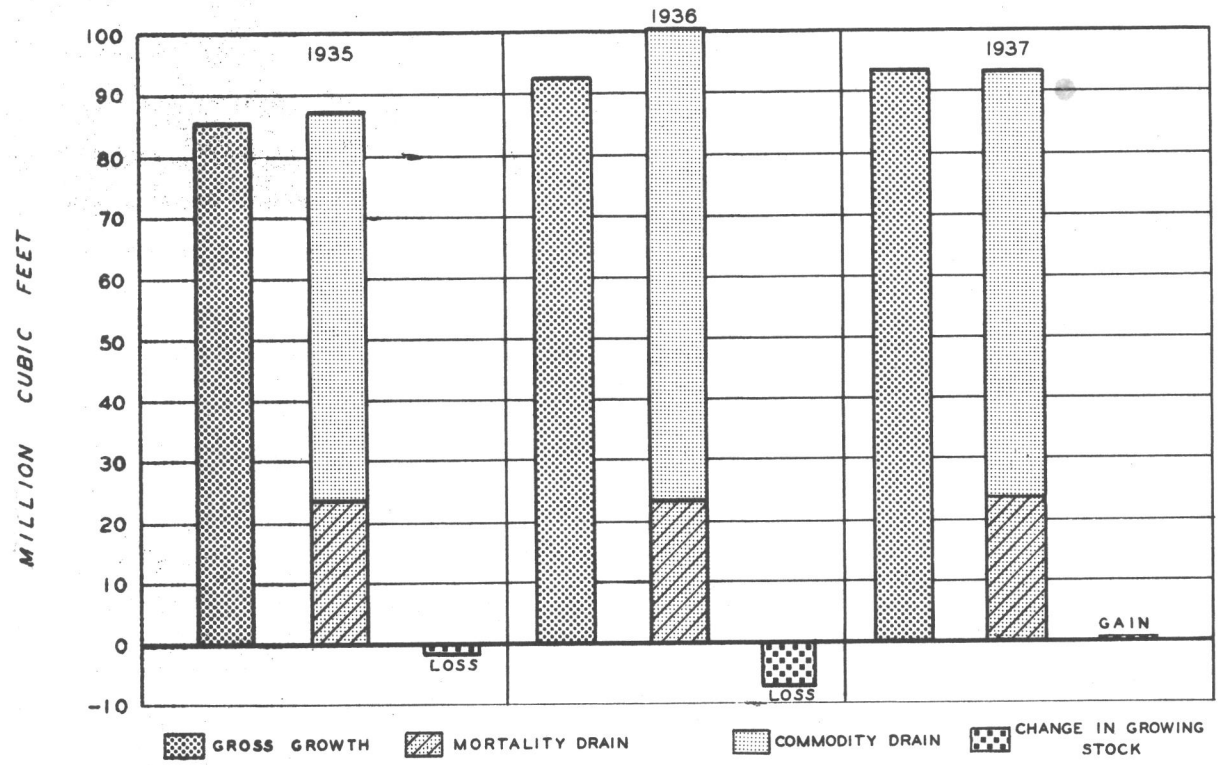

FIGURE 5.- COMPARISON OF GROSS GROWTH AND TOTAL DRAIN OF ENTIRE GROWING STOCK.

volume cut for lumber, veneer, and cooperage material. The remainder comes from class-B areas largely by clearing land, cutting fuel wood, and cutting for other domestic uses.

Comparison of Increment and Drain

Timber-inventory data are based on field work done chiefly during the latter part of 1934 and early 1935, and represent conditions as of Jan. 1, 1935. Subsequent changes in this growing stock caused by additions due to growth and by subtractions due to cutting timber and natural mortality are shown in table 10.

Table 10. - Changes in the growing stock

Date	Saw-timber material	All trees 5.0 inches d.b.h. and larger
	M bd. ft. (lumber tally)	M cu. ft. (i.b.)
Jan. 1, 1935	6,223,400	1,911,240
Jan. 1, 1936	6,174,800	1,909,250
Jan. 1, 1937	6,055,800	1,901,880
Jan. 1, 1938	5,991,700	1,901,980

From this table we see that both the board-foot volume and the cubic volume of the growing stock (all trees 5.0 inches d.b.h. and larger) have declined during the 3-year period. Although the total amount of this reduction is so small that no lack of wood supply seems probable for many years to come, the situation is by no means satisfactory. The most serious aspect of this comparison of increment and drain is from the point of view of timber of the kind and quality required by forest industries. It is estimated that in 1935 the increment on the higher-quality (class-A) areas was 160 million board feet, whereas the corresponding drain was more than 200 million board feet. In 1937 it is estimated that the drain on class-A areas had risen to more than 230 million board feet, which indicates an alarming overcut of the areas upon which the industrial plants of the unit chiefly rely for their raw material. Since over half the board-foot drain is the result of lumbering operations, it would appear that until a considerable part of the area now classed as class B is transformed into class A through growth and development, or unless the sawmill requirements for standing timber are reduced, this unbalanced condition will continue.

A more detailed picture of the balance of increment and drain is shown in table 11, where it is seen that the 1937 loss through natural mortality was 72 million board feet, or more than 20 percent of the commodity drain. To the extent that this loss can be either reduced or salvaged, the deficit in board-foot growing stock can be decreased without reducing the quantity cut. In figures 4 and 5 the gross growth and total drain are compared graphically, and in figure 6 is shown the net effect of growth and drain on the saw-timber growing stock.

Table 11. - Comparison of increment with drain, 1937

Item	Saw-timber material	All trees 5.0 inches d.b.h. and larger
	M bd.ft. (lumber tally)	M cu.ft. (i.b.)
Growing stock, Jan. 1, 1937	6,055,800	1,901,880
Growth	350,300	93,460
Mortality	71,600	23,630
Net increment	278,700	69,830
Commodity drain	342,800	69,730
Net change in growing stock	-64,100	100
Growing stock, Jan. 1, 1938	5,991,700	1,901,980

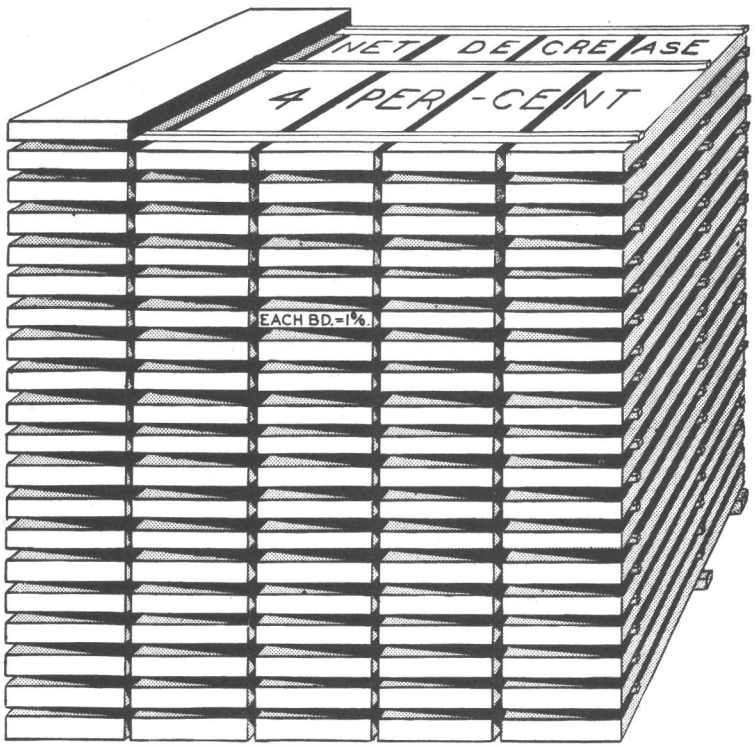

FIGURE 6.- SAW-TIMBER GROWING STOCK AND NET CHANGE DUE TO INCREMENT AND DRAIN FOR THE 3 YEARS ENDING DEC. 31, 1937.

Outlook for the Future

In general, the forests of this unit have deteriorated badly, and the present excess of board-foot drain over increment is depleting the forest capital still more. Only 12 percent of the total forest area bears at least 1,000 board feet per acre of the grade of logs usable for the manufacture of industrial lumber, veneer, cooperage material, and similar products. The remaining 88 percent is characterized either by thrifty, rapid-growing, but immature growing stock, or by residual, but largely unmerchantable, mature trees left after heavy cutting. From the point of view of merchantable raw materials, this unit has a glorious past and a promising future but a very limited present.

The soils of this unit are almost entirely alluvial and, in the main, are suitable for agriculture. There is every indication that, as low prices for agricultural crops tend to force farmers from the less fertile upland soils into the river bottoms, the clearing away of the forest to make more land available for agricultural use will continue and possibly be accelerated. It is doubtful, however, if the forest area ever will be reduced below 25 or 30 percent of the total area, and it does not seem likely that such a shrinkage will take place for many years. This means that at least 1½ million acres of forest land can be expected to continue permanently in timber production. Of this total, approximately 150,000 acres is batture land along the Mississippi and Arkansas Rivers. Owing to its untenable position for farming, because of the flood hazard, and its very favorable tax situation, the continued use of this class of land for timber production by private landowners is practically assured.

For the immediate future, a shrinkage in the volume of timber used in the manufacture of industrial lumber, veneer, and cooperage, is inevitable. The growing stock in its present stage of development is unsuited, both in quantity and quality, to meet continuously the needs of the existing plants. Some of the larger sawmills presumably will cease operations in the relatively near future, owing to the lack of accessible timber supplies of suitable quality. Gradually, as the forest industries become adjusted to the quantity and quality of timber available for use, and as the present immature growing stock increases in volume through growth and approaches maturity, an expansion in the industries may be expected. As a matter of fact, even if the forest area is reduced eventually through continued agricultural development to the minimum of 1½ million acres, but in the meantime the growing stock is built up to yield an average annual increment per acre equal to that of the better-stocked second-growth stands, it will supply a larger sustained annual yield than the whole area does now; this yield would more than meet the present industrial and domestic overdraft on the area.

In order to increase the timber increment in this unit to a point that will permit the maximum permanent development of the forest industries, a number of improvements in forestry practices are needed:

1. An effective program for prevention and suppression of forest fires. Even on the wettest situations in the bottom lands, fires in the dry season damage severely the standing timber, causing a loss in actual volume, largely through subsequent decay, and a reduction in grade or quality of part of the timber that is not destroyed. Furthermore, these fires effectively prevent the establishment and development of an adequate stand of young trees.

2. Improvement in the quality and composition of forest stands. Defective and slow-growing trees and those of the commercially inferior species should be removed from all stands to make room for the establishment and growth of thriftier trees of the more valuable species. The taking of more of the domestic fuel wood, fence posts, and similar material from low-quality residual trees, from cull timber, and from thinnings rather than from sound, thrifty trees, would help to accomplish the desired end; and the development of the use of low-quality trees for conversion into chemicals, pulp, fibers, etc., would further materially the silvicultural betterment of the stands.

3. The full and most economic use of the trees cut. All portions of trees should be converted into the products for which they are best suited — sawlogs, cooperage and veneer stock, bolts, ties, etc. — rather than be used arbitrarily for a single product or discarded. This end can be accomplished best by the practice of diversified utilization, in which the landowner disposes of all the products of his forest. This could be done and an additional economy be attained if all the trees to be removed from a stand were cut in closely-timed operations, and the resulting logs and bolts marketed for the best use their size and quality permitted.

The first two measures, if generally carried out, will do much to place the forest land of this unit in a position for maximum timber production and thereby permit the development of a diversified forest industry, in balance with its supply of raw material, furnishing employment to many people, and adding considerably to the local industrial income. The third measure will go far toward making practicable the type of selective cutting needed to improve the present stands through coordination with conservative management practices. In this unit, where farm land and woodland are generally intermingled, timber cropping of forest land should be a desirable adjunct to agriculture, since it provides material for domestic use and off-season woods employment for farm labor; in addition, the sale of woods products adds to the farm or plantation income. Although the measures listed above can be applied by almost anyone interested in making his woodland contribute most to his needs, there is a demand for an expansion of extension work to explain the idea of timber culture and to demonstrate that in this area there is a definite place for both timber culture and agriculture.

In brief, the outlook for the immediate future in this unit comprises (a) a slowly shrinking forest area, as a result of conversion to agricultural lands; (b) a continuing excess of forest drain over increment; and (c) a decrease in the volume of production of higher-grade industrial forest commodities. Although the superior claim of farm crops to the fertile soils of this favorably located section of the Delta must be recognized, successful agriculture always will depend upon a convenient, adequate supply of wood for the production of fence posts, fuel wood and other domestic-use material, as well as raw materials for sale. Furthermore, in all parts of the unit there are certain extensive areas primarily suitable for forests that cannot be converted readily or economically to agricultural crops. On some of these areas, notably on the batture lands, the commercial growing of timber seems very feasible. Owners of such lands and of other forest land not suited for crops should be

aided to develop the forest possibilities of their lands to the full capacity of the sites, through tax relief, extension work in forestry, cooperative fire-protection service, and the development of new markets for material now unsalable. In this way will the forest lands best serve their owners and the communities in which they occur.